View IWS - Unabridged:

IWS/SP #:	WAL:	IWS Status:	Date Created:
12639 r93 [*Not Restricted*]	**C**	**Authorized** on **28-OCT-05**	**12-APR-05**

Title:

Jupiter Laser Facility

Scope of Work:

This IWS covers the operation and maintenance of the Janus Laser System, including the COMET Laser, the Callisto Laser, and the Titan laboratory. Acting within this IWS/SP, Janus may operate at the full capabilities of the system with two independent beams of 1000 J at 1053 nm, 800 J at 527 nm, and 600 J at 351 nm with a 3 ns to 10 us pulse width. Pulse widths between 170 ps and 3 ns are also possible with reduced energy. COMET Laser may operate at up to 20 J at 1053nm, 10 J at 527 nm, or 5 J at 351 nm in a pulsewidth of 500 fs to 300 ps. The Janus pumped Callisto Laser may operate at up to 20 J at 800 nm or 14 J at 400 nm in 80 fs. The three named lasers are capable of coordinated operation into a single target room. The Titan experimental area (room 1506) compresses a chirped 1053 nm beam from Janus and produces up to two 500 J beams with a 500 fs to 200 ps pulsewidth. An additional uncompressed Janus beam is also available in Titan.

The operations described in this plan will be conducted in B-174. The Janus laser is located in room 1101, with the COMET Laser located in rooms 1106 and 1107 and Callisto in room 1110. Power supplies for the lasers are in Modules 1, 2, and 3 East of B-174, and Module 5 West of B-174. System controls are located in room 1103. Target rooms are in rooms 1107, 1108, 1110, 1305, and 1506. The system operational areas are diagrammed in an attachment.

The LLNL ES&H Manual requires a Safety Plan (WAL C IWS) for the use of Class 4 lasers; the use of Class 3 and 4 lasers by non-laboratory personnel; interlock systems with multiple, separately interlocked zones; and the operation of experimental high energy electrical systems.

The use and disposal of chemicals in the B-174 Rm-1304 darkroom is covered by IWS-12969. Pulsed power operations are covered in IWS-12805.

ISM Authorization Method:

Services - User facility

Intended Start Date:	Estimated Completion Date:
On-Going	On-Going

Location of the Activity:

1) LLNL-Facility - Bldg: 174 - Room: 1101, 1103, 1106, 1107, 1108, 1110, 1302, 1305, 1306, 1308 and 1506 - ES&H Team 3 - Misc: (Haz Com = Y)

Authorizing Organization:

AD-Physics and Advanced Tech (PAT) • V - Division

Funding Organization:

AD-Physics and Advanced Tech (PAT) • V - Division

Management Chain for the Activity:

Name:	Title:	Phone:	Beeper:
PRICE, DWIGHT F	RI	36170	05492
BONLIE, JAMES D	Alt RI	33826	05560
ECKART, MARK J	AI	34383	--
OSTERHELD, ALBERT L	V-Division Leader	37432	--
GOLDSTEIN, WILLIAM H	AD-P&AT	22515	--
--	AD-Physics and Advanced Tech (PAT)	--	--

Employees and Guests Assigned to this Activity and their Associated Requirements:	Read & Sign
_____	
_____	
_____	

_____

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_____ _____ _____

_____ _____

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Additional Training Information:

Additional institutional and facility-specific training requirements for individuals may be specified in LTRAIN.

Electrical Workers: Employees who perform electrical work on class 3 or class 4 electrical equipment shall be trained to recognize the hazards associated with their work environment and know how to minimize the risk of an accident or injury using appropriate procedures and protective equipment. The electrical safety courses listed above (*) are awareness training courses and do not automatically qualify employees as electrical workers. Payroll supervisors shall verify the qualifications and training of electrical workers before they are permitted to perform such electrical work. Training requirements are identified in Document 16.1, “Electrical Safety” in the ES&H Manual. The RI shall identify those authorized as electrical workers and ensure they have read this IWS.

The RI shall ensure that all required training is complete and documented. Those who have not completed the required training may not perform tasks requiring training unless they are directly supervised by a fully qualified individual.

Before starting operation, the RI shall verify and document that the operating personnel have read and understand the contents of this IWS, all applicable references stated in the controls of this IWS, and applicable sections of the FSP.

The supervisor or RI shall train employees on the use of all required personal protective equipment (PPE) specified in this IWS. Training shall include when PPE is required, how to properly don, doff, adjust, and wear the PPE, limitations of the PPE, and proper care and maintenance of required PPE.

General Hazard Control Information:

No general hazard controls specified.

Hazard Descriptions and Controls:

Chemical (Hazardous Material): Beryllium *(Significant Environmental Aspect)*

Description:

Beryllium windows are occasionally used in the target chamber. The potential routes of exposure to Be include inhalation, skin contact, and ingestion. The most significant route of exposure is inhalation, which may produce acute and chronic lung disease. However, Be is handled intact in the Janus Facility so inhalation is not anticipated to be a concern. Accidental implantation of Be under the skin causes ulceration which will not heal until the Be is surgically removed. Be is classified as a suspect human carcinogen. Beryllium is considered extremely hazardous (California) and acutely hazardous (federal).

Control:

Any work with beryllium or beryllium containing materials other than windows will require additional review by ES&H Team 3.

Be must be properly handled and stored. Be shall be stored in a sealed container (such as a dry box) that is appropriately labeled. Be windows and foils shall not be cut in this laboratory (this type of operation is not covered under this IWS). Personnel shall wear non-surgical latex or nitrile gloves and ensure that all work surfaces remain free of contamination by covering them prior to handling Be foils. After handling foils, the work area shall be cleaned using wet methods or vacuuming with a certified HEPA-filtered vacuum cleaner. If surface contamination is suspected the area shall be swipe sampled to ensure that surface contamination levels are less than 0.2 micrograms per 100 square centimeters. If surface levels are greater than this level, the area shall be re-cleaned and re-swiped.

If a foil breaks or if a work surface is contaminated, contact the ES&H Team 3 Technician for clean up and decontamination guidance.

Additional information on the storage and handling of Be is available in Document 14.4, Implementation of the Chronic Beryllium Disease Prevention Program Requirements, in the ES&H Manual.

Chemical (Hazardous Material): Materials of special concern (e.g., alkali metals, fluorine, asbestos, lead, mercury, PCB) *(Significant Environmental Aspect)*

Description:

Lead bricks and lead sheets are sometimes used to provide shielding for certain experiments. Lead dust can be generated during the handling of lead shielding materials. Prolonged exposure to lead or lead compounds in high concentration can cause gastrointestinal disturbances and damage to several organ systems. Organ systems affected include nervous system, blood, reproductive system, and the kidneys. Damage to the kidneys and nervous system is permanent. The primary route of exposure is inhalation followed by ingestion. Inorganic lead and lead compounds are not known to be absorbed through intact skin.

Control:

Whenever possible lead should be encapsulated to reduce exposure. Handling of <25 lead bricks in a single 8-hour workshift is permissible and has been determined by air sampling to not require special permits. Leather gloves (or equivalent) shall be used when handling unencapsulated lead bricks or shielding. Lead awareness training is required for personnel performing the work. Employees shall wash their hands subsequent to handling the lead bricks.

The handling of 25 or more lead bricks in a single 8-hour workshift or more than 25 lb of lead shot or beads, unless they are fully encapsulated requires a permit. A “Lead Work Permit” outlining appropriate controls to be followed when performing lead work that exceed conditions and amounts listed in the ES&H Manual shall be completed by the employee performing the work and signed by the ES&H Team Industrial Hygienist.

The machining of lead is not allowed at the Jupiter Facility, nor is it covered under this IWS.

Additional information on the proper handling of lead and exposure limits can be found in Document 14.10, “Safe Handling of Lead and Lead Compounds in General Industry and Construction Operations” in the ES&H Manual.

Chemical (Hazardous Material): Flammable, volatile or fuming *(Significant Environmental Aspect)*

Description:

Small quantities of acetone, ethanol, isopropyl and methanol are used on disposable wipes to clean lens surfaces and components on an incidental basis. Acetone, ethanol, methanol, and isopropyl alcohol are flammable. They are all central nervous system depressants and inhalation, ingestion, or skin contact can cause systemic toxicity. Repeated skin contact may also cause dermatitis. Exposure to these materials is anticipated to be negligible during normal operations.

Control:

Small quantities will be used. These chemicals shall be labeled. Whenever possible, the use of small labeled <500ml containers with secondary containment will limit the amount of material out of the primary fire storage cabinets. Transportation of hazardous chemicals in glass bottles from locations outside of the chemical use area shall be done using a plastic bottle carrier bucket or other non-breakable containment. PPE for large quantity use of alcohol shall be safety glasses and butyl rubber gloves. Nitrile gloves may be worn for incidental contact, but glove changes will be done if contact with the alcohol is known or suspected.

Information regarding the hazards of these materials can be obtained by reviewing the Material Safety Data Sheets (MSDS) for these substances. MSDSs can be obtained by calling the MSDS Hotline at Ext. 2-5238, or on the web at http://www-orad2.llnl.gov/web2/chemtrack/ MSDS/MSDS.html.

Additional information on the storage, transportation, and disposal of chemicals can be found in Document 14.1, “Chemicals” and Document 22.5, “Fire” in the ES&H Manual.

Construction/Equipment/Working Surfaces: Moving/lifting large or heavy items (including use of cranes/hoists, powered lift)

Description:

The Jupiter facility uses several specialized cranes and pre-engineered lifts to place heavy loads and optics into position. Lifting loads (less than 500 lbs.) with cranes or hoists may cause serious injury from falling objects.

Heavy components in an elevated positions also presents a seismic risk to personnel unless properly engineered. A support frame has been designed to support a laser disk amplifier with its supporting hardware at a height above five feet in room 1101. Estimated weight around 400 lbs.

Control:

Only certified operators may operate cranes or hoists.
The lifting of Janus components with any of the cranes or hoists shall be done using the manufacturers written operation procedures. Approved and certified rigging will be used. Crane inspections must be current. No unsupported load should be left unattended.

The amplifier support frame in room 1101 was engineered to meet LLNL seismic requirements. The mechanical and seismic strength of the support frame is documented in MESN05-500012-AA

Additional information on the use of cranes and lifts can be found in Document 15.2, “Manual and Mechanical Material Handling” in the ES&H Manual.

Construction/Equipment/Working Surfaces: Welding, soldering, thermal cutting

Description:

There is bench soldering of small components with electric hand held soldering irons conducted in most rooms. Combustion of flammable items near the work area is a concern.

Control:

The work area is confined to the bench in each room.
The soldering irons will be turned on only when needed. Portable fire extinguishers are available near each work area. Work areas are maintained non-combustible when soldering operations are being conducted.

Discharges to Air: Solvents, adhesives, coatings

Description:

Operations in B174 use solvents for wipe cleaning. Solvents used may include acetone, isopropyl alcohol, ethanol, and methanol.

Control:

The Main Site BAAQMD wipe-cleaning permit issued to LLNL covers all solvent wipe-cleaning operations for facilities which do not have air permits and which use only incidental amounts of solvents. The purchase of any solvent that will be used for these incidental wipe-cleaning operations must be tracked. This will require the purchaser to go through their TRR who will coordinate the solvent usage with the LLNL ChemTrack Group. This will ensure that solvents are automatically tracked by ChemTrack and that the annual usage is reported in the Main Site permit. Any continual solvent wipe-cleaning operation that will use a large volume of solvents, usually more than 5 gallons a year, must be evaluated for a separate air permit. Contact the ES&H Team Environmental Analyst for more information.

An effort shall be made to minimize the use of methanol as a wipe cleaning solvent. Because it is a Hazardous Air Pollutant regulated by the Clean Air Act, its use is subject to stricter reporting requirements than the other solvents used.

Electrical: Capacitors (>10 J electrical energy)

Description:

The Jupiter facility laser systems employs several high voltage capacitor banks to operate the laser. There are several High Voltage power supplies of up to 20kV @ 400mA as well as the total of 1,120 kJ of capacitor banks within the four power supply modules. These High Voltage charging supplies and capacitor bank systems individually pose a potentially lethal electrical shock hazard. High voltage electrical shock to personnel from possible transient high voltage (25 kV) on laser tables or instrumentation racks caused by insulation failure in high voltage cables could cause serious or lethal personal injury.

Control:

Work in the capacitor banks and on electrical components connected to the capacitor banks is covered under IWS/SP-12805 and is limited to qualified personnel identified by that IWS.

Protection from electrical shock due to cable insulation failure during a high voltage discharge shall be accomplished by the following steps:

* All tables and racks will be adequately grounded

* An announcement will be made prior to charging any capacitor bank stating the capacitor banks are about to be charged.

* Orders will be given to stand clear of all tables and consoles.
and to leave room 1101 in the case of a shot.

Work in the laser area on any potentially energized connection from a power supply module shall be preceded by the safing of the capacitor bank in the associated power supply modules as per IWS/SP-12805. The responsibility for initiating this step rests with the employee who will work on the potentially energized connection.
After the power supply module capacitor banks have been safed, the repair of any laser component can begin after disconnecting the component from its junction box by disconnecting the appropriate

plug-in cables. A lockout device is not needed if powered by a cord and plug provided that the plug is under the positive control of the worker and the device is safed.

Should the laser system or other equipment display an abnormal event that implicates the high voltage systems, routine power supply safing shall not be performed until this has been evaluated. The areas where potentially energized high voltage components and cables are present throughout the facility must be secured to reduce the risk of a serious electrical shock.

Electrical: Electrical power source (>140 V or >30 A or >10 J of electrical, or 2 or more sources of electrical power)

Description:

The Jupiter Laser Facility has numerous potential electrical shock hazards. Work in either the control room or the target rooms provides a possibility for electrical shock from 110 and 220 volt AC utility power circuits and from energized equipment. Experiments will also utilize various sources of high voltage power in experiments and diagnostics.

Control:

All electrical equipment and conductors shall be considered energized until otherwise verified by a qualified and authorized person. Lockout and tag procedures shall be used during maintenance and servicing.

Modifications, repair, and testing of high voltage, pulse power, or capacitor bank systems shall be done only by personnel authorized by the RI in conjunction with the Electronic Engineering Supervisor.

Electrical safety interlocks shall not be bypassed unless authorized by the RI or his or her alternate. Electrical safety interlock bypass shall be prominently identified at control console and at the location where the hazard exists. Electrical safety interlock bypasses that are not self-resetting at the end of the operation shall be recorded in the Janus operations / maintenance logbooks. Appropriate replacement safety controls (e.g., safety barriers, warning lights, and administrative controls) shall be used.

All metal topped optical tables must be grounded.

All electrical equipment must be UL listed or equivalent per AHJ.

This document does not authorize work on energized electrical equipment. If work is to be done on any energized equipment, a separate IWS and work procedure shall be written and approved. This work must be evaluated for Electrical Hazard Class 3 work in accordance with Document 16.2, "Work and Design Controls for Electrical Equipment" in the ES&H Manual.

Additional information on safe practices, limitations, and lock and tag can be found in Document 16.1, "Electrical Safety", Document 16.2, "Work and Design Controls for Electrical Equipment", and Document 12.6, "LLNL Lockout/Tagout Program" in the ES&H Manual.

Electrical: Other electrical

Description:

An Explosive release of energy stored in non-PCB capacitor banks located in transportainers outside the building and other electrical components (total explosive potential = 0.2 lbs. of TNT equivalent) is possible.

Control:

To reduce the risk of exposure to flying debris if stored energy were released somewhere other than a laser head, no personnel are allowed to remain in the Janus laser bay or capacitor banks during full system or rod shots. When required for diagnostic or inspection purposes an exemption can be made by the Responsible Individual or his deputy . A notation will be made in the maintenance log. Protection from possible flying debris from electrical arcs is provided by requiring personnel to stay as far from the components as possible. The amplifiers are designed to hold the electrical arc and not come apart.

Pressure/Noise/Hazardous Atmospheres: Low Pressure systems <150 psig-gas, <1500 psig liquid, <100 kJ stored energy

Description:

Low pressure gas is frequently used for purging and venting target chambers and controlling valves and mechanical devices. The use of low pressure compressed air and non flammable gases represents a potential hazard due to the energy release from component failure or the possible over pressurization of target chambers.

Control:

IWS 12373 addresses work with low pressure systems and the required controls.

Pressure regulators should be inspected prior to use to determine the compatibility with the gas in use and to ensure that the pressure inspection is current. All chambers that use pressurized gas to vent must have valid pressure relief devices to prevent explosive failure from over pressurization. Damaged or suspect components should never be used.

Pressure/Noise/Hazardous Atmospheres: High pressure system >150 psig-gas or >1500 psig liquid >=100 kJ stored energy

Description:

High pressure gas puff valves are often used to provide gas targets for laser interactions. High pressure is also used in Raman conversion tubes to shift the laser wavelength. The use of high pressure gas represents a potential hazard due to the energy release from component failure or over pressurization of target chambers.

Control:

All systems using >150 psi require an Engineering Safety Note (ESN). Pressure regulators should be inspected prior to use to determine the compatibility with the gas in use and that the pressure inspection is current. High pressure systems must be assembled by qualified pressure installers and remotely tested by LLNL pressure inspectors.
The high-pressure gas jet systems and their use in the target chambers are discussed in Engineering Safety Note MESN03-007-AA. The H2/D2 gas target work is described in MESN01-052-OB. The H2 Raman cell is described in Engineering Safety Note MESN99-060-OA.

Pressure/Noise/Hazardous Atmospheres: Pressure systems containing hazardous fluids **(Requires SP)**

Description:

Flammable gases such as deuterium, deuterated methane, methane, and hydrogen may be used in gas puff valves as target materials in the facility or as interaction gases in Raman converter cells. High pressure flammable gases represent a potential hazard from fire or explosion.
Hydrogen gas can form ignitable mixtures between 4 and 75 percent by volume in air. Given confinement, hydrogen can be detonated over the range of 18 to 59 percent by volume in air. Hydrogen also has an extremely low ignition-energy requirement. A 20-µJ spark can ignite a stoichiometric hydrogen/air mixture.

Control:

The maximum amount of gas to be in the room at one time will be one bottle of 400 liters at standard pressure and temperature. Additional bottles of gas will be stored outside, away from potential sources of ignition or oxidizers.
The rooms are of sufficient volume that if the entire contents of a full bottle of flammable gas leaked with no ventilation turn over, the Lower Explosive Limit for the gas would not be reached.
Only pressure regulators and manifolds approved for use with flammable gases will be used.
The exhaust from vacuum pumping equipment that has the potential to exhaust flammable gases will be directed outside of the building.
A separate operating procedure for the handling of flammable gas is attached. At a minimum it will address the following:
* Connecting a gas bottle to the manifold.
* Pressurizing the gas delivery system.
* Evacuating the gas delivery system.
* Changing gas types at the supply manifold.
* Pulsed solenoid valve operation when used.
* Response to a loss of vacuum.
* Response to a flammable gas leak.
* The limitation on ignition sources around the system area.
* Response to a large flammable gas leak into the vacuum chamber.

In the event of a large flammable gas leak when possible, safely shut off the cylinder and manifold valve. If the leak remains evacuate the area and contact the LLNL Fire Department(911) with the event location and material involved. Contact the FPOC and RI.

The total inventory of deuterium in B-174 must be maintained below 500 grams in order to prevent accountability requirements.

The H2/D2 gas target work is described in MESN01-052-OB and MESN03-007-AB. The H2 Raman cell is described in Engineering Safety Note MESN99-060-OA.

Hazardous or Radioactive Materials & Equipment that Present a Hazard (SP Info):

Item 1 · General Information:
Type: HAZARDOUS MATERIAL
Desc: Flammable Gases: H2, D2, Methane
Comment:

Use Location		***Storage Location***	
Qty · UOM	400 · liter	**Qty · UOM**	2000 · liters
Loc Site · Fac · Rm · Comnt	LLNL-Facility · 174 · 1101, 1103, 1106, 1107, 1108, 1110, 1302, 1305, 1306, 1308 and 1506 · none	**Loc Site · Fac · Rm · Comnt**	LLNL-Facility · none · none · none

Pressure/Noise/Hazardous Atmospheres: Vacuum systems

Description:

Vacuum systems are used for the target chambers and compressors in the Jupiter facility. Hazards include damage of system or components due to reduced internal pressure, overpressure from pressurized backfill gas, window breakage and explosive venting, or oil vapors from exhaust of pumps.

Control:

Only systems and components rated for vacuum service will be used in the construction of vacuum systems. Backfill of vacuum systems will generally be from air, but if inert gas sources are used, they will be equipped with a suitably sized and tested pressure relief valve. Pumps operated under conditions that generate oil vapor will be equipped with an oil vapor trap or be vented outside. Care must be exercised when working near glass vacuum ports to ensure that tool do not impact the window.

Pressure/Noise/Hazardous Atmospheres: Cryogens

Description:

Liquid nitrogen is supplied from laboratory approved 250 liter transport containers for cryogenic target shots and vacuum system use. Liquid nitrogen (LN) is used in adsorption pumps and “cold fingers” to help establish and maintain vacuums. Frostbite is the major hazard associated with LN. Skin contact by splashes while transferring LN from small Dewars is a concern. However, contact with cold metal surfaces is the most common means of exposure. Frostbite damage occurs during the thawing of tissue. Intense hyperemia (abnormal accumulation of blood) normally occurs in affected tissues. This can result in the formation of blood clots, which may decrease local blood circulation and cause gangrene. Small amounts of less than a liter are used in the cold traps.

LN is only used in the building laboratories in small quantities (~2 liters). The small volume of LN in use compared to the typical room size results in a negligible asphyxiation hazard. LN is transported from the outside storage tanks to the use location in open top LN Jugs. All uses entail open cold-fingers or Dewars. There are no hazards due to trapped LN expansion. Any confined LN or LHe system developed will require a separate IWS to be generated.

Control:

Dewars, process vessels, and piping shall be labeled with the common name of the cryogenic liquid (liquid nitrogen). Labels can be obtained from the area H&S Technician. Each component of the cryogenic system must be engineered for pressure and must have an uninterruptible pressure relief to allow routine off-gassing of expanding gases.

At minimum, safety glasses with side shields are required any time cryogenic liquid, exposed to atmosphere, is present. Goggles provide the best protection for eyes. Full face shields and an apron should be used when the potential for splashing exists. Gloves shall be used when handling cryogens and must be loose, non-asbestos insulating gloves, special cryogen gloves, or leather gloves without gauntlets that can be tossed off readily. Shoes shall be closed toe and clothing long-sleeved and non-absorbent.

Transferring LN at or above chest level shall be avoided as it presents an additional splash hazard to the eyes. Where necessary, platforms or approved stools will be used.

Additional information on Cryogens can be found in Document 18.5, “Cryogens” in the ES&H Manual shall be used when handling cryogens.

Pressure/Noise/Hazardous Atmospheres: Confined spaces/oxygen deficiency, asphyxiant

Description:

The compressor and target chamber in room 1506 are non-permit confined spaces. The compressor is 5 foot in diameter and 24 foot long. Entry is often required to reach components. The potential hazards include limited egress and restricted communication with other workers in the area.

The pulse compression chambers in rooms 1107 and 1110 are not confined spaces. Under normal use entry into the compressors is not possible due to the restricted volume. They are operated under a vacuum, but are brought up to atmospheric pressure with nitrogen backfilling. Nitrogen is a simple asphyxiate, depriving the individual of oxygen. This can result in unconsciousness and death. Atmospheres containing less than 19.5% O2 are treated as oxygen deficient Access to components inside is provided by removing large plates and working from the outside.

Control:

All employees who perform work in confined spaces are required to be trained in confined space entry prior to initial work. Confined spaces will be posted and hazards clearly spelled out.
The compressor and target chamber in 1506 are non permit confined spaces. They will remain non-permit as long as no additional hazards are introduced into the space either by completion of a work task or change in experimental focus. These vessels are vented to compressed air and purged with HEPA filtered air at high flow rates. A safety watch is required for entry into the compressor. Full entry into the target vessel is not required and access is achieved by reaching in.

The compressors of room 1107 and 1110 are not confined spaces. Normal work within these compressors shall be performed from the exterior by reaching in. After venting the vacuum turn off N2 venting system. By removing the side plate doors and waiting 5 minutes sufficient air exchange will occur to insure a non-hazardous atmosphere. Never block off ports in such a manner that air exchange is restricted.

The target chambers of 1110, 1006, 1108, and 1305 have sufficiently large doors that air exchange is not a concern. They have all technically been considered not to be confined spaces, although hazards may still exist. Contact the health and safety technician if any questions arise.

Radiation- Ionizing/Non-Ionizing: Radiation-generating devices (RGD) (accelerator, x-ray machine, e-beam, high voltage in a vacuum)

Description:

X-ray, neutron, and particle beams are common by-products of short pulse (<200ps) laser interaction with matter. Exposure to x-ray radiation from laser shots in room 1506 (Titan) is a potential hazard for the roof area of B-174, the fenced in corporate yard, the utility & storage room 1506C, and the ceiling areas near 1506 (R-1302,1306,1308,1507,1508,and 1509).

Measured x-ray yield outside of the target chamber of room 1110 indicate that low Z or thin windows will transmit 10-100 mrad per shot. This is a significant potential exposure based on a 240 shot month. LLNL dose limits per year are 5 rem. Actual x-ray yield is highly dependent on target material and intensity. The target chamber is currently characterized as a Class 1 Radiation Generating Device (RGD#234) in accordance with Document 20.3, “LLNL Radiological Safety Program for Radiation-Generating Devices” in the ES&H Manual.

Ionizing X-rays from the laser-produced plasmas and Pockels Cell drivers can present a hazard.

Neutron Radiation:
The interaction of intense and ultra-short laser pulses with D2 or T2 target materials can produce neutron radiation. These pulses can produce up to 10^8 2.5 MeV neutrons per pulse (two pulses per hour) in room 1110. Higher levels are possible in 1506. The calculated maximum dose per pulse at the surface of the room 1110 chamber is 130 µrem. At a distance of 3 feet from the chamber this decreases to approximately 15 µrem per pulse.

Control:

Occupied areas around room 1506 are protected by concrete walls. Room 1506C, the corporate yard and the roof will be maintained as restricted areas by lock out procedures. Access may be granted by the primary laser operator when a shot is not scheduled. After access these areas will be swept and locked out. Access to the ceiling near room 1506 will be administratively controlled and must be coordinated with the building FPOC and laser operators. Advisories on the doors to these areas and verbal announcements prior to shots will serve as alerts to the status of the facility.
Room 1506 and 1110 will be evacuated prior to all focused shots of greater than 1 J. The Experiments Responsible Individual (ERI) or his designee will clear the room, lock out the area, and inform the laser operator that the room is clear and ready for a shot. Upon re-entry to the target chamber of 1506 scans with a hand held radiation meters will be periodically perform to detect build up of activation. The ERI will be trained by the facility RI or his alternate in the proper conduct of these responsibilities. Target chambers may require designation as Radiation Generating Devices (RGDs).

For the Comet and Janus target chambers exposure from target shots is insignificant (<0.1 mrem/shot) based on past measurements. Radiological surveys are required when laser power is increased or thinner windows are used. Special IWSs are required when a potential target material is anticipated to generate significantly higher radiation. Contact the ES&H Team Health Physicist for guidance.

Survey of the Callisto target chamber indicates over 100 mrem/shot. This is a significant potential exposure based on a 240 shot month. The target chamber is classified as a Class I RGD. All personnel must be removed from the target room during a target shot on Callisto and the room locked out.

The vacuum tubes, such as planar triodes and thyratrons, generate X-rays whenever high voltage is

applied to them. Generator Models 3148 to 3156 inclusive incorporate a hydrogen thyratron, which can emit X-rays. Based on previous measurements, the CX 1588 thyratron used in model 3148 generates a moderate flux of X-rays when operating at 9 kV or higher output voltages. The intensity can exceed 24 mrem/hr at 10 cm from the tube when operating at 10 kV output peak voltage and can exceed 200 mrem/hr when the driver is operating at the tube breakdown voltage (approximately 12 kV output peak voltage). The emission is limited in a region perpendicular to the tube axis between the anode and grids. (Details of measurements are given in a memo [MSS860513/MSS/sh] from M. Singh to J. Hunt dated May 27, 1986.)
The X-ray hazard potential posed by the vacuum tubes (such as planar triodes and hydrogen thyratrons) shall be considered prior to doing maintenance, troubleshooting, evaluation, or development work in the Pockels Cell drivers when high voltage is applied to them. The area H&S Technician shall be contacted before such work and shall make an X-ray survey to verify the adequacy of shielding. If the X-ray flux can expose workers to levels in excess of 2.5 mR/hr, turn off the unit and call the ES&H Team Health Physicist for evaluation and guidance

Personnel should maintain their dose ALARA by keeping the distance between the chamber and themselves as far as practical during the pulses and taking advantage of any incidental shielding that may be in place.

Radiation- Ionizing/Non-Ionizing: Non-ionizing radiation— class 3a — unattended or invisible, 3b, or 4 lasers, or intense UV, visible, or infrared illumination **(Requires SP)**

Description:

The lasers used in this operation represent a significant source of personnel hazard. These lasers can cause eye damage including blindness, skin damage, or cause the combustion of flammable materials or cloths. The use of laser beams generated in one room (rooms 1101 and 1106) and directed into another room (rooms 1106, 1107, 1108, 1110, 1305 and 1506) can result in exposure to the laser by those not working with the laser. Long term skin exposure to ultraviolet laser beams may increase the chance of skin cancer.
The safe exposure limits to the Class 3 and 4 lasers are shown in the appended Lasers Table.

Control:

To be authorized to work with class 3 or 4 lasers or receive the cipher for entry to the laser containment areas personnel must received a laser eye exam, be current in Laser Safety (HS5200), and read and signed this IWS. Appointments for an examination can be made through Health Services.

Safety from exposure to laser beams is provided by:
*Containment of the laser beam within rooms 1101, 1106, 1107, 1108, 1110, 1305 , and 1506.
*Administrative control of entry into any Containment Areas
*Interlocks on the entrance doors to these rooms.
*The use of appropriate protective eyewear within any containment area.
* Exclusion from containment areas of 1101, 1108, 1110, 1305, and 1506 during all rod or system shots.
*A procedural sequence used when preparing target rooms and containment area for use. (See attached Alignment Procedure).

Laser beam containment shall be accomplished by door interlocks, partitions, and beam tubes. They shall not hinder emergency entrance or exit. Containment Areas are defined as a region which contains all direct or secular reflections of a particular laser and from which any diffuse scatter of light must be below the appropriate Maximum Permissible Exposure level. During any operation that could result in beam movement, the Containment Area is any region into which a beam could be directed. The RI, or his or her alternate, is responsible for maintaining the operation of the laser containment devices.

The door interlocks allow access by authorized personnel via cipher code to the containment area during alignment. The interlock override is for 15 seconds. The interlock bypass is inoperative during any shot or charging sequence. Opening a door to the laser area by an unauthorized person shall crowbar the electrical systems and activate laser beam shutters within the room. The people bypassing the interlock (either from the outside with a push-button code or from the inside by pushing the bypass button) shall make sure that those to whom they allow entrance are aware of the hazards within and that they are prepared for safe entry (eyewear) and participation.

An announcement shall be made prior to any change in the laser condition within a given area stating that the particular operation will commence and that all persons within the given containment area shall wear appropriate eye protection. A visual sweep shall be made to ensure compliance with these requirements.

The only allowed occupancy of the laser bay or target rooms 1108, 1110, 1305, or 1506 during a shots is for troubleshooting. When all other means have been exhausted, authorization may be granted on a case-by-case basis by the RI or his alternate with a written record in the log.
Laser protective eyewear shall be worn whenever so instructed by laser operators (when the alignment laser is about to be turned on, when laser shots are to be fired, or when entering any Containment Area). Approved laser safety glasses supplied by the facility should be used. This eyewear is available for visitors at the Janus Laser entrances or from operations staff. The eyewear provides adequate protection for the multiple wavelength at use at the Jupiter facility.
Protective clothing should be worn when working with uncontained UV beams whenever skin exposure is possible above the skin MPE. This clothing shall consist of long-sleeved shirts or jackets, lab coats, and white clean room gloves. These beams are a UV skin-exposure hazard but are not powerful enough to be a beam fire hazard.

The prevention of a clothing fire from high intensity beams is accomplished by beam tubes and fire resistant barriers where necessary. Care should be taken to avoid beam proximity to cables.

General techniques applicable to the safe alignment of laser beams along with specific procedures used by the operators to insure that the containment areas and target rooms are properly prepared prior to laser operation, are attached in the alignment procedures.

Alignment of the lasers and laser systems shall follow the alignment procedures attached to the IWS/SP

Hazardous or Radioactive Materials & Equipment that Present a Hazard (SP Info):

Item 1 · General Information:
Type: HAZARDOUS EQUIPMENT
Desc: Multiple Class 3B and Class 4 Lasers
Comment: See attached Laser Table

Use Location		***Storage Location***	
Qty · UOM	n/a · n/a	**Qty · UOM**	n/a · n/a
Loc Site · Fac · Rm · Comnt	LLNL-Facility · 174 · 1101, 1103, 1106, 1107, 1108, 1110, 1302, 1305, 1306, 1308 and 1506 · none	**Loc Site · Fac · Rm · Comnt**	LLNL-Facility · none · none · none

Radiation- Ionizing/Non-Ionizing: Electric/magnetic fields < 3 kHz

Description:

Magnetic fields to 4 Tesla are produced by pulsed and permanent sources in the laser bays. No specific target organ for the harmful effects of magnetic fields exposure has been identified at the present time. Magnetic fields can affect cardiac pacemakers and prosthetic devices composed of ferromagnetic materials.

Control:

Pulsed magnetic field exposure will be minimal since participants are directed to stay away from the Faraday rotator coils when they are pulsed and the exposure will only be to 1 millisecond pulses at less than 100 gauss and then only occasionally. The area around the pulsed and static magnetic fields shall be posted with safe field distances.
Additional information can be found in Document 20.7, “Nonionizing Radiation and Fields” in the ES&H Manual.

Waste: Hazardous waste

Description:

Small amounts of hazardous waste will be generated from the hazardous materials noted in sections above.

Control:

Personnel responsible for hazardous waste must be current with EP0006 COR and HZ which will allow them to sign the waste disposal registration. The waste shall be segregated based on compatibility, waste type (hazardous, radioactive, mixed), and form (solid or liquid). Liquid waste must have secondary containment. Waste labels will be filled out to describe the waste characteristics and to track the 9 month accumulation limit. Waste containers will be located at the point of generation and under the operators control at all times.

Material contaminated with 75 ppm or more by weight of beryllium is regulated as hazardous waste. Any material with greater than 7500 ppm is considerd extremely hazardous waste and had additional restrictions on time and volume limits. Contact the Environmental Analyst or RHWM Field Technician immediately upon generating any beryllium waste with these elevated concentrations.

All material that is contaminated with Be shall either be decontaminated or disposed of as Be waste.

For all other types of hazardous wase contact the RHWM Field Tech for proper disposal.

Additional information can be found in the ES&H manual, document 36.1 and 36.3

Waste: Other waste

Description:

Small volumes of solid waste are generated from wipe cleaning operations and may include wipes, rags, and cotton swabs which have been exposed to solvents.

Control:

Wipes, which are damp or saturated after use, must be managed as hazardous waste. However, if the wipes are dry after use, the wipes are non-hazardous and may be thrown in the trash. Note: it is not permissible to set the wipe aside after use to allow it to dry.

Potential Accidents and Consequences:

The use of high power Class 4 lasers can present serious personnel eye hazards and create fire/burn hazards. Electrical shock can generate flash burns, produce impact injury or death. Flammable gases repesent a fire and explosion hazard that could lead to significant property loss or severe injury.

Other 'Key ES&H Limits' not specified in 'Hazard Descriptions and Controls':

None

Maintenance, Inspections, and Quality Assurance:

The RI is responsible for ensuring that all required maintenance of safety systems and equipment is conducted at the recommended frequencies. This includes scheduling maintenance with Plant Engineering, or where applicable, an outside vendor service organization. All laser door safety interlocks are to be tested for proper operation at least semi-annually. A written laser interlock test procedure shall be developed and reviewed by the ES&H Team. A written record of this safety check and the proper functioning of the interlocks is to be maintained by the RI in an appropriate file or notebook. Maintenance of the electrical systems shall be performed only by qualified personnel. A list of qualified personnel shall be maintained by the RI. Electrical interlocks shall be tested quarterly and records maintained. Entries shall be made in the system interlock logbook whenever interlocks are bypassed. The entries shall be certified by the RI. All cranes, hoists, and slings shall be inspected prior to use. All cranes, hoists, and slings shall be formally inspected monthly or locked out of service and tagged with an administrative “Caution” label to alert potential users of the inspection requirements that must be met prior to using the equipment. Cranes or hoists that have been idle for less than six months require a monthly inspection prior to use. Those that have been idle for more than six months shall have an annual inspection prior to use. Verifications of inspections shall be performed by a representative of the ES&H Team and reviewed by the ES&H Team Industrial Safety Engineer. Cranes and lifting fixtures shall be load tested every three years. Records of these tests and inspections shall be maintained. For verification of safety routines, checks, and inspections regarding quality assurance, contact the area H&S Technician.

Emergency Response Plans and Procedures:

Emergency assembly point locations are displayed on maps near the building entrances. In the case of an earthquake, proceed to the nearest assembly point and follow instructions issued there. In case of fire or other emergency, evacuate and notify the LLNL Fire Department by Dialing 9-1-1 from the nearest telephone in a safe location (or dial 925-447-6880 from a cell phone). Stay on the phone until the dispatcher has the location and nature of the emergency. If necessary, post someone to guide the Fire Department to the incident. The use of flammable and combustible liquids in the Janus facility requires that fire extinguishers be provided for Class B hazards according to NFPA 10 “Standard for Portable Fire Extinguishers.” This Work Smart Standard stipulates that a fire extinguisher of minimum 20-B rating be located within 50 ft of any location where flammable or combustible liquids are used or stored. Only persons trained in fire extinguisher use may attempt to fight a fire (after calling 911) and only if it is safe to do so. In the case of electrical shock, Dial 9-1-1. All electrical shock victims shall be transported to the appropriate medical facility by the Fire Department due to the potential for delayed cardiac failure. Injuries and medical illness that do not require an ambulance response, but do warrant medical attention, should be transported to Health Services by an uninjured party. If in doubt of the seriousness of the injury, Dial 9-1-1. In the unlikely event of frostbite, report to Health Services or contact Emergency Services by Dialing 911. Procedures for major emergencies are covered in the PAT Self Help Plan. Notify ES&H Team 3, the PAT Assurance Manager, and appropriate management staff as soon as time permits of any emergency. In the event of a hazardous material or waste spill, follow the procedures outlined in the B-174 FSP. If you suspect a laser eye exposure, complete the following: 1. If necessary, Immediately call 911 [(925) 447-6880 from a cell phone]. 2. During working hours report to HSD for evaluation; if after hours, report to emergency room or urgent care facility for evaluation (do NOT drive yourself). Remain in a sitting position during transport and examination to prevent further damage to the retina, if damage to a blood vessel in the eye is

suspected. 3. Notify your supervisor and others in the work area. 4. Safe the laser and leave the scene unchanged. Anyone who witnesses or discovers a serious electric shock that results in any of the conditions listed below, shall immediately call the Fire Department Emergency Rescue (dial 911) (from a cell-phone, call 925-447-6880). 1. Obvious serious injury (e.g., loss of consciousness, significant trauma). 2. Altered mental status (e.g., confusion, slow/slurred speech). 3. Other obvious injury (e.g., laceration, muscle strain, burn). In addition to calling 911: * Ensure that all potential sources of energy are safe and in a neutral state, if you are qualified. * Initiate cardiopulmonary resuscitation (CPR), if appropriate. (Only trained personnel should perform this task.) A Lifepak Automated External Defibrillator is located in B174 Control Room (Room 1103). All other electric shock victims must be taken to the Health Services Department for evaluation so that potentially damaging effects can be detected early and treated properly. It should be noted that such effects may not be immediately recognized and can appear later. Do not let the shock victim drive himself to the Health Services Department. Notify the facility RI (or Alternate RI), FPOC and ES&H Team 3 as soon as possible.

Attached Files:

Type:	Name:	Links:
Attached	B-174 Map	B-174 Map - [Download]
Attached	MOU	MOU - [Download]
Attached	Rad. Characterization	Rad. Characterization - [Download]
Attached	Lasers Table	Lasers Table - [Download]
Attached	Flammable Gas Procedure	Flammable Gas Procedure - [Download]
Attached	Pre-Start Review	Pre-Start Review - [Download]
Attached	Jupiter facility Alignment Procedures	Jupiter facility Alignment Procedures - [Download]
Attached	OJT for Operators	OJT for Operators - [Download]
Attached	Interlock Check procedures	Interlock Check procedures - [Download]
Attached	Safety Notes, ENN & MESN	Safety Notes, ENN & MESN - [Download]

Referenced Files:

Type:	Name:	Location:
FSP	B174	B174 Control Room
OTHER	IWS-12805	eIWS
OTHER	IWS-12373	eIWS
OTHER	MESN03-007-AA	Eng. Print Room

ES&H Documents Needed:

None Specified.

Additional Site Location/Directorate-Specific Information:*Additional requirements that need to be met before work can commence*

None Specified.

LLNL Permits/Approvals/Consultations/Reporting:

None Specified.

Agency Work Permits/Approvals:

None Specified.

Signatures:

As the RI, I have reviewed the hazards and agree to implement the controls identified in this IWS:

PRICE, DWIGHT F RESPONSIBLE INDIVIDUAL (RI)	08/30/2005 DATE

The proposed work falls within the safety envelope of the facility/area and may commence once authorized:

SPRAGGE, MAURA K FPOC CONCURRENCE, LLNL-Facility - Bldg: 174 - Room: 1101, 1103, 1106, 1107, 1108, 1110, 1302, 1305, 1306, 1308 and 1506	10/04/2005 DATE

The hazards and controls have been properly identified and the work may commence once authorized:

BORENSTEIN, PAUL E ES&H CONCURRENCE, ES&H Team 3·LLNL-Facility - Bldg: 174 - Room: 1101, 1103, 1106, 1107, 1108, 1110, 1302, 1305, 1306, 1308 and 1506	10/19/2005 DATE

I have reviewed the hazards and controls for this work and concur that the work may commence once authorized:

HOLTE, SEAN M ADDITIONAL CONCURRENCE	SSO TITLE	10/28/2005 DATE

Approval: The controls have been confirmed and this proposed activity is authorized to proceed.

ECKART, MARK J AUTHORIZING INDIVIDUAL (AI)	10/28/2005 DATE

Jupiter Facility Flammable Gas Handling Procedure

1.0 Location and Scope

This safety procedure is required by IWS-12639. It defines safe procedures for the handling of flammable gases on a occasional and temporary basis in the target rooms of the facility. Work under this procedure shall be accomplished only by those employees qualified and authorized to perform such work by the RI for IWS-12639.

2.0 Equipment Description

The basic safety manifold is shown in figure 1. It consists of a DOT approved gas supply cylinder containing at most 400 liters of flammable gas. The regulator shall have the proper CGA connections and be certified by LLNL for compatibility with the gas in use and must be current in its pressure inspection. The regulator is equipped with an inlet and outlet pressure gauge. The manifold contains a pressure relief device sized to the maximum pressure and flow rate possible and a vent valve to manually vent the outlet side of the pressure manifold. All vents and purges will be connected to an unobstructed vent line to the outside of the building. An isolation valve/shut-off valve can be used to separate the manifold from the puff valve or Raman gas cell. The manifold will also contain a gas purge supply valve or vacuum valve allowing the outlet side to be evacuated or purged prior to use.

Specific manifold diagrams can be found in the MESN safety notes and should be studied and understood by the operators of the systems. The diagrams of the manifold systems should be posted near the manifold to facilitate quick reference.

More complex systems many require a specific procedure and IWS be generated.

3.0 Procedures

Verify that the gas cylinder and threads are proper connections for the manifold and in good shape, free of debris and grease.

Verify that the manifold, cylinder and chamber areas are free of ignition source and that other personnel working in the area are aware of the use of flammable gases and are instructed to be conscious of not introducing heat or ignition sources in the area.

Connect the gas cylinder to the manifold.

Set the pressure regulator to zero or minimum pressure

Evacuate the manifold, puff valve, or pressure cell to prevent the production of an explosive atmosphere when flammable gas is added.

> An alternative is to purge the system with ~90 psi of N2 or other inert gas and then shutting the purge gas valve inlet, venting the purge gas and shutting the vent at slight

positive pressure. This should be repeated 3 times to reduce the presence of O2 on the outlet side of the manifold.

Close the pump valve or purge and vent valves.

Close the outlet valve

Crack open the flammable gas cylinder to just indicate cylinder pressure then close. Listen and observe the gauges for leaks. Check for a pressure drop indicating a leak. If a leak is present close the cylinder and have a qualified person check the system.

Open the regulator pressure and observe the manifold does not leak. The inlet pressure should not continue to drop. If a leak is present close the cylinder and have a qualified person check the system.

Open the outlet valve. Depending on the manifold and experiment cell volume the supply cylinder many need to be open and closed again to achieve sufficient pressure to verify that there are no leaks. If a leak is present close the cylinder and have a qualified person check the system.

Open the Cylinder slightly for operation.

Set the regulator to the working pressure of the experiment.

If the use of flammable gas is small it is advisable to shut off the supply cylinder and run off the regulator "charge" to minimize the amount of flammable gas available in an uncontrolled vent.

When operation is complete and at the end of the day, or to change gas cylinders or gas type, close off the cylinder in use.

Slowly vent the manifold on the approved vent line.

Evacuate the manifold or repeat the 3x purge process with a inert gas.

Insure that the supply side of the regulator vents as well. Then proceed.

4.0 Problems / Faults

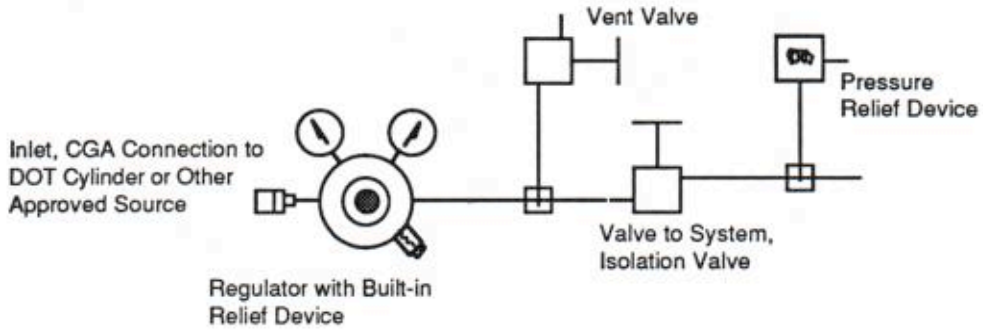
The vacuum chambers are of sufficient volume that failure of the gas puff seal can not produce a positive pressure. The vacuum system can be used to vent the chamber safely to the building outside. However if vacuum is lost the valve operations must be suspended as quickly as possible and the cylinder and manifold valved off. The manifold and supply side should be evacuated or purged as described above to remove the issue of flammable gases.

In the event of a large flammable gas leak when possible, safely shut off the cylinder and manifold valve. If the leak remains evacuate the area and contact 911 with the event location and material involved. Contact the FPOC or RI.

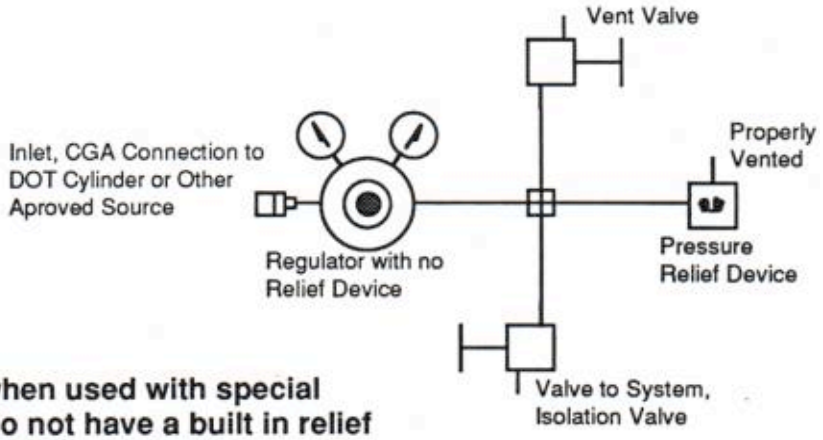
The maximum amount of gas to be in the room at one time will be one bottle of 400 liters at standard pressure and temperature. Additional bottles of gas will be stored outside, away from potential sources of ignition or oxidizers.

The rooms are of sufficient volume that if the entire contents of a full bottle of flammable gas leaked with no ventilation turn over, the Lower Explosive Limit for the gas would not be reached.

Figure 1 Gas Manifolds



Manifold layout where regulator has its own relief device to protect gages and other components. This is the preferred layout for most common, non-toxic, non-flamable gas manifolds used at LLNL.
Also reference ENS 87-922.



Alternate lay-out when used with special regulators which do not have a built in relief device and when flammable gases need to be properly vented. This manifold shall not be used for systems which do not have their own pressure relief protection.

Janus Laser Mixed Gas Plasma Experiments
Operational Procedure
B-174 /R-1108

The following procedure describes the operation of the high pressure gas delivery system for the mixed gas plasma experiments on the Janus laser. Included are responses to vacuum loss and flammable leaks.

The system will be evacuated prior to any gas filling or mixing to at least -28 inches Hg.

Evacuating the gas mix pressure vessel and gas delivery system.

1. Close the hydrogen isolation valve.
2. Close the helium isolation valve.
3. Open the gas supply isolation valve.
4. Open the chamber isolation valve.
5. Open the vacuum valve and monitor the 3000 psi gauge for a of 0-psia reading.
6. Close the vacuum valve.

Connecting a gas bottle to the gas delivery system.

The hydrogen and helium bottle manifolds connect to the gas delivery system through separate 1/4-inch stainless steel tube with 1/4-inch Swagelok tube connections. Insert the preswaged ferrel end of the tubing into the fitting body of the bottle manifold and tighten the nut by hand. Use a wrench and slightly tighten the fitting beyond the point of increasing resistance. Connect the other end of the tubing to the gas delivery system. Then perform the following steps:

1. Close the hydrogen isolation valve on the gas delivery system.
2. Close the vent and isolation valves on the hydrogen bottle manifold.
3. Open the bottle shutoff valve.
4. Set the bottle regulator to the desired pressure.
5. Open the manifold isolation valve. The flex line will pressurize.
6. Close the bottle shutoff valve.
7. Open the vent valve on the manifold momentary and close.
8. Open the bottle shutoff valve again and repressurize the flex line.

Repeat for the helium bottle.

Evacuating the target chamber

1. Complete the alignment of the gas jet nozzle and Janus laser beam.

2. Close and latch the target chamber access door.
3. Activate the target chamber pumping system. Wait for base pressure to drop below 10^-3 torr before operating gas delivery system and solenoid valve.

Limiting ignition sources around the system area.

1. Shut off all pressure reading devices attached to the target chamber prior to pressurizing the gas mix vessel and delivery system.

Pressurizing the gas mix pressure vessel and delivery system.

1. Open the 3000 psi gauge isolation valve.
2. Open the proper gas isolation valve and fill the vessel to desired partial pressure.
3. Close the gas isolation valve.
4. Open the other gas isolation valve and fill the vessel to desired total pressure.
5. Close the gas isolation valve.

Disconnecting a gas bottle from the gas delivery system.

1. Close the gas isolation valve on the gas delivery system.
2. Close the bottle shutoff valve.
3. Open the bottle manifold isolation valve.
4. Open the bottle manifold vent valve.

Response to a loss of vacuum.

1. Close the chamber isolation valve.
2. Determine the source for the loss of vacuum.
3. If repairs will take a long period of time, perform the procedure above for evacuating the gas mix pressure vessel.

Response to a flammable gas leak into R-1108.

1. Close the hydrogen bottle shutoff valve.
2. Open the hydrogen gas bottle manifold vent valve.
3. Open the hydrogen gas delivery system vent valve.
4. Open the hydrogen gas isolation valve.

Response to a flammable gas leak into the vacuum chamber.

1. Close the chamber isolation valve.
2. Close the hydrogen bottle shutoff valve.
3. Activate the chamber vacuum pump, if not already operating, and allow sufficient time for chamber to evacuate.

DRAFT - 2/25/98

Pat Crawford

DRAFT - 2/24/98

P. Crawford

MEMORANDUM OF UNDERSTANDING

FOR BUILDING 174

FEBRUARY 1998

1.0 Introduction

Building 174 is assigned to the Physics and Space Technology Directorate. The Laser Directorate occupies part of the building as a tenant. This Memorandum of Understanding (MOU) is intended to outline the respective Environmental, Safety, and Health (ES&H) responsibilities for the two Directorates.

2.0 Term of MOU

This MOU shall remain in force until such time as there is a mutually agreed upon transfer of responsibilities or a change in operation requiring the deactivation of the laser operation. It will be reviewed annually by the Directorate Assurance Managers to resolve any issues or problems.

3.0 ES&H Responsibilities

Physics and Space Technology (P&ST) will bear the primary ES&H responsibilities associated with Laser Directorate operations in the facility. This will include compliance with all relevant Laboratory policies and procedures, DOE Orders, and requirements of outside agencies. The P&ST Assurance Manager is responsible for initial reporting of any occurrence resulting from Laser Directorate activities. All requests for major facility maintenance and modifications will be reviewed by the P&ST Facility Manager for B-174 before work commences. Laser operations will be subject to the P&ST Self-Assessment Plan, including formal self-assessments and informal walk-throughs of laboratory areas by P&ST and Team 3 personnel.

ES&H Team 3 is responsible for review of all operations and for the coordination of publishing the FSP. The Laser Directorate Responsible Person is responsible for submitting a P&ST Integration Worksheet for new activities or major changes to existing activities and for coordinating the preparation of any necessary OSP with the P&ST Safety Support Officer and ES&H Team 3. Training requirements will be entered into LTRAIN by the payroll directorate and will be checked for completion by the P&ST Training Officer. A laser eye exam must be completed by each employee before working in laboratories containing lasers.

A formal activation of new experimental activities will be required before these activities are allowed to

commence. This activation, or management prestart review, will be conducted by P&ST, Laser, and Team #3 personnel.

The Laser Directorate Assurance Manager is responsible for follow on reporting of any occurrence resulting from Laser Directorate activities. Any deficiencies identified by self-assessments in the Laser Directorate Laboratories will be corrected by the Laser Directorate Responsible Person.

If the Laser Directorate vacates the facility, it will be responsible for conducting shutdown or transfer of operations according to Health and Safety Manual Supplement 2.10 and for correcting all ES&H deficiencies associated with its specific space prior to departure.

MOU For Building 174 Laser Acceleration - 2/98

Ronald E. Schwartz Robert M. Feinberg

Deputy Associate Director for Operations Deputy Associate Director for Operations

Physics and Space Technology Laser Program

Patricia C. Crawford William Hatcher

Assurance Manager Assurance Manager

Physics and Space Technology Laser Program

Table 1 - ES&H Responsibilities for B-174 Laser Operations

Responsible Directorate

Program AD Laser

Facility AD Physics and Space Technology

Facility Manager, Jim Wittmayer

ES&H Team Support Team 3

Occurrence Reporting P&ST (initial)

Laser (follow-up)

ES&H compliance inspections P&ST

Deficiency Tracking

Documentation

FSP - (Team 3) to be developed

Integration Worksheets Laser provides to P&ST

OSPs - (Team 3) Laser

Approval:

Program Leader (Level B)

M. Campbell, Laser AD (Level A)

Concurrence:

J. Wittmayer, Facility Manager

A. Celoni, ES&H Team 3 Leader

R. Schwartz, P&ST AD/Operations

Training

Program related - identification Laser

Facility related - identification P&ST

LTRAIN Payroll AD

Check for completion P&ST

Prestart Review (new activities) Laser

P&ST

Team 3

Shutdown/Transfer Laser

LASERS TABLE (IWS/SP 12639) RI Dwight Price 9/20/05 New — Calculation by Lazan Plus 3.67 + manual (RN) Form Rev. 07/18/05

Laser identification					Laser specifications								Direct eye exposure				Diffuse eye exposure			Skin exposure
ID #	Type	Make & Model	Com-ments	Class	Wave-length (nm)	Mode	Beam Size (mm)	Diver-gence (mrad)	Power CW (mW)	Pulse Energy (J)	Pulse Length (ns)	Pulse Rate (Hz)	Time (s)	MPE (mW/cm^2)	NOHD fiber (m)	Min. OD	Time (s)	NOHD (m)	Min. OD @ 0.5 m	MPE for 10 s (mW/cm^2)
1	Nd:YAG (2)	Quanta Ray GCR5 GCR4	Rooms*	4	1064	P	8	0.5	-	1.2	6-10	10	10	15.8**µW/cm²**	-	≥ 6.2	600	4.92	≥ 2.0	1000
					532					0.7			0.25	3.8**µW/cm²**		≥ 6.6		11.9	≥ 2.8	200
2	Nd:YAG (3)	Quanta Ray GCR150 GCR11	Rooms*	4	1064	P	8	0.5	-	0.355	6-10	10	10	15.8**µW/cm²**	-	≥ 5.7	600	2.67	≥ 1.5	1000
					532					0.185			0.25	3.8**µW/cm²**		≥ 6.0		6.1	≥ 2.2	200
3	Argon Ion (2)	Spectra-Physics 2080-205	Rooms*	4	488	CW	1.65	0.5	10**W**	-	-	-	0.25	2.55	-	≥ 4.1	600	0.744	≥ 0.4	200
					514													0.564	≥ 0.1	
4	Ti:Sapph	Spectra-Physics Tsunami	Rooms*	3b	1053	CW	1.5	0.5	0.25**W**	-	-	-	10	5.0	-	≥ 2.2	600	39.9**mm**	0	1000
				4		P				5 **nJ**	100 **fs**	82 **MHz**		4.73		≥ 2.4		52.5**mm**	0	Unknown
5	Ti:Sapph	Spectra-Physics Tsunami	Rooms*	4	800	CW	1.5	0.5	1.5**W**	-	-	-	10	1.58	-	≥ 3.4	600	0.174	0	317
						P				18 **nJ**	80 **fs**	82 **MHz**				≥ 1.7**		17.1**mm**	≥ 0.3	Unknown
6	Nd:YAG	NanoLase 1060-100	Rooms*	3b	1064	P	0.3	6	-	3 **nJ**	1	6 **kHz**	10	1.92	-	0	600	.547**mm**	0	1000
					532					40 **nJ**			0.25	0.482				.631**mm**		200
7	Ti:Sapph	JanUSP	Room 1110	4	800	Single P	150	1	-	25	80 **fs**	1/**40 min**	-	19**nJ/cm²**	-	≥ 7.2**	-	205	≥ 5.5**	Unknown
					400					14				12**nJ/cm²**		≥ 7.1**		193	≥ 5.4**	
8	Glass	Janus	Rooms*	4	1053	Single P	100	1.2	-	1500	6	1/**40 min**	-	5**µJ/cm²**	-	≥ 6.6	-	97.7	≥ 4.6	100**mJ/cm²**
					527					900				0.5**µJ/cm²**		≥ 7.4		239	≥ 5.4	20**mJ/cm²**
					351					200				4.93**mJ/cm²**		≥ 2.8		1.14	≥ 0.8	4.93**mJ/cm²**
9	Glass	Comet	Rooms*	4	1053	Single P	50	1.0	-	20	1 **ps**	.1/**min**	-	0.15**µJ/cm²**	-	≥ 6.9	-	65.1	≥ 4.3	Unknown
					527					10				15**nJ/cm²**		≥ 7.6		146	≥ 5.0	
10	Nd:YLF Regen	LLNL Janus Reg	Rooms 1306 & 1101	4	1053	P	240	.05	-	.02	5	10	10	15.8**µW/cm²**	-	≥ 1.5	600	0.635	≥ 0.3	1000
11	Nd:YLF	CrystaLaser IRCL-200-1053-SLM	Rooms 1306 & 1101	3b	1053	CW	0.45	3	200	-	-	-	10	5.0	-	≥ 2.1	600	35.7mm	0	1000
Misc	HeNe, diode	Various	Several	2-3b	400-700	CW	~1	> 0.42	≤ 15	-	-	-	0.25	2.55	-	≤ 1.2	600	< 0.1	0	200

SPECIFIC COMMENTS: * Rooms 1101, 1106, 1107, 1108, and 1305. ** Present laser safety eyewear protection does provide full protection. OD correction factor for laser faster than 100 fs is derived by the following equation:

$$OD_{20fs} = OD_{100fs} + \log\left(\frac{100\,fs}{80\,fs}\right)$$

WAVELENGTH: at which the laser is operated or capable of operating; **UV** < 400 nm, **VIS** 400 to < 700 nm, **IR** ≥ 700 nm, (**near-IR** ≥ 700 to < 1400 nm, **far-IR** ≥ 1400 nm).

LASER SPECS: typically listed for the smallest accessible beam size, highest power or pulse energy, shortest pulse length, and highest rep-rate.

EXPOSURE TIME: MPEs depend on the length of exposure. Use the actual pulse duration for single pulses; use the following (or greater) for CW or rep-rated pulses:

direct eye exposure: **UV** - 10-30,000 s (i.e., 8-hr work day) (depends on expected exposure time and assumes 2 successive days exposure); **VIS** - 0.25 s (i.e., blink response time) or at least 1/Hz; **all IR** - 10 s.

diffuse eye exposure: **UV** - 600-30,000 s (i.e., 8-hr work day) (depends on expected exposure time); **VIS or near-IR** - 600 s; **far-IR** - 10 s.

skin exposure: **all wavelengths** - 10 s.

MPE: Maximum **P**ermissible **E**xposure for unintentional, intrabeam (direct) exposures for the listed duration – typically in mW/cm^2 for CW or rep-rated (≥ 1 Hz) beams and mJ/cm^2 for single pulses at < 1 Hz. Purposeful direct viewing is not permitted unless authorized specifically in an IWS/SP.

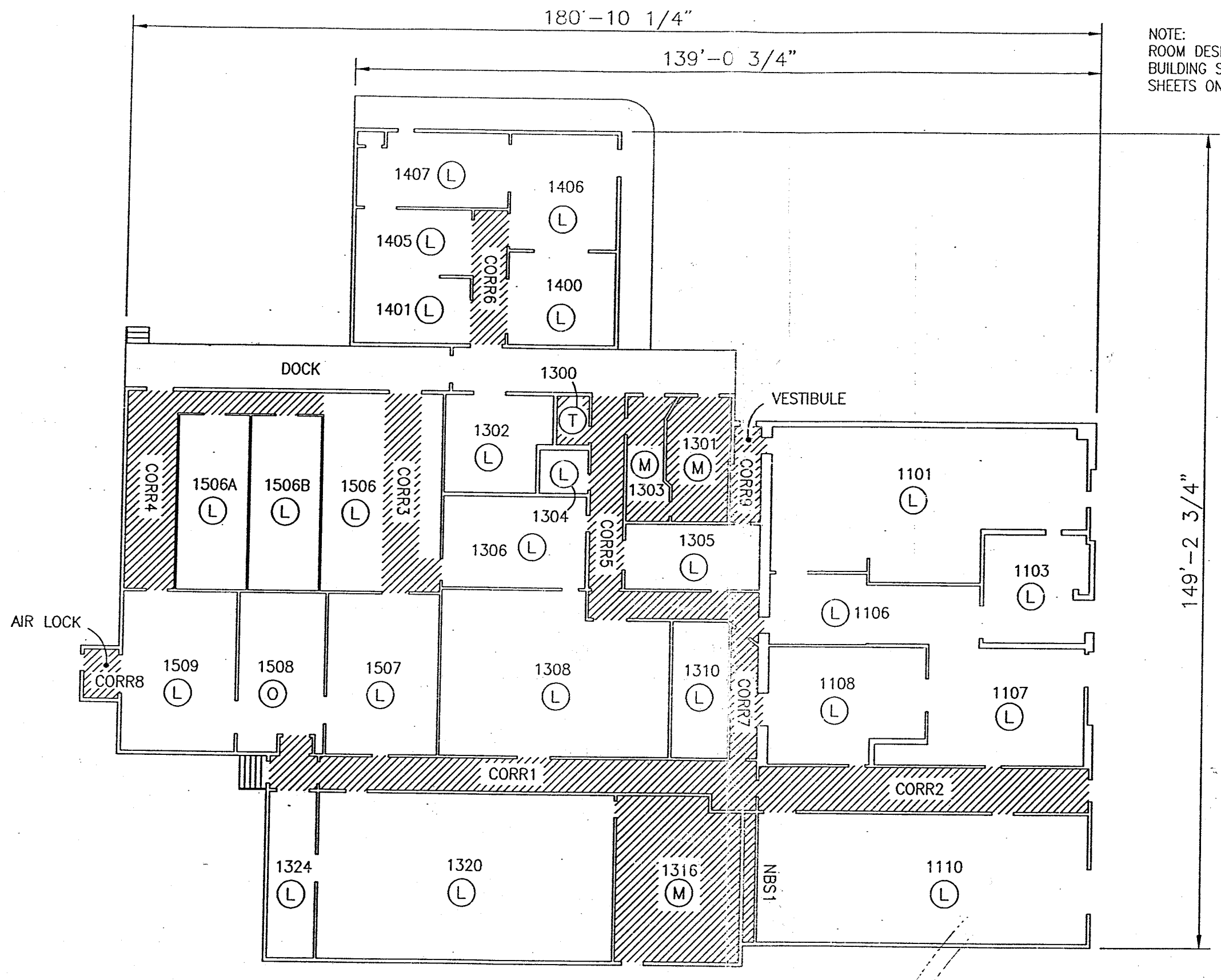
OD: minimum **O**ptical **D**ensity eyewear (at the designated wavelength) for full protection to MPE levels, typically at a distance of 0.5 m from a source. Optically aided viewing with telescopes, microscopes, cameras, etc. may require higher OD. **Note**: "alignment eyewear" for **visible beams 400-700 nm** may be used with an OD reduced by as much as 1.2 than specified in the "Min. OD" column (OD 1.2 is the equivalent to reduce a 15-mW HeNe to MPE level). Employ caution to avoid direct and stray beams. Since there is no aversion response to diffuse light, do not go below the OD level specified in the diffuse "Min. OD @ 0.5 m" column without LSO or OSP-documented approval.

DIFFUSE EXPOSURES: based on 100% Lambertian reflection at normal incidence from a non-specular surface at a nominal arm-length distance of 0.5 m.

NOHD: Nominal **O**cular **H**azard **D**istance beyond which laser viewing is safe without eyewear (listed for fiber output and occasionally for unaided viewing of diffuse beams if warranted).

SUB-NANOSECOND: ocular calculations in the **VIS** and **near-IR** are based on ANSI Z136.1-2000. Present technology on laser safety eyewear causes the OD to be reduced significantly on femtosecond pulsed lasers, due to bleaching of the lens material. Laser eyewear may not provide adequate protection for sub-nanosecond lasers. Additional controls may be necessary to protect personnel from eye exposure.

SKIN MPE: "Unknown" means biological data is unavailable, and there is no known MPE for exposure times < 1ns.



NOTE:
ROOM DESIGNATIONS FOR CORRIDORS, STAIRWAYS AND NON-BUILDING SPACE ARE FOR CROSSREFERENCE TO AREA SHEETS ONLY.

NORTH

Scale: 1" = 20'

0 10 20 40

REV	DESCRIPTION	DATE	DWN	APPR
B	RPIS UPDATE	02/98	W2	

DO NOT REVISE THIS DRAWING

ALL MODIFICATIONS AND REVISIONS TO THIS DOCUMENT MUST BE REPORTED TO THE P.E./CADDS FACILITY (EXT. 2-0491)

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LAB BUILDING 174

Facility Name: RESEARCH

CONTROLLED

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Livermore CA 94550
PLANT ENGINEERING

FACILITY KEYPLAN

PKB96-174-001BB